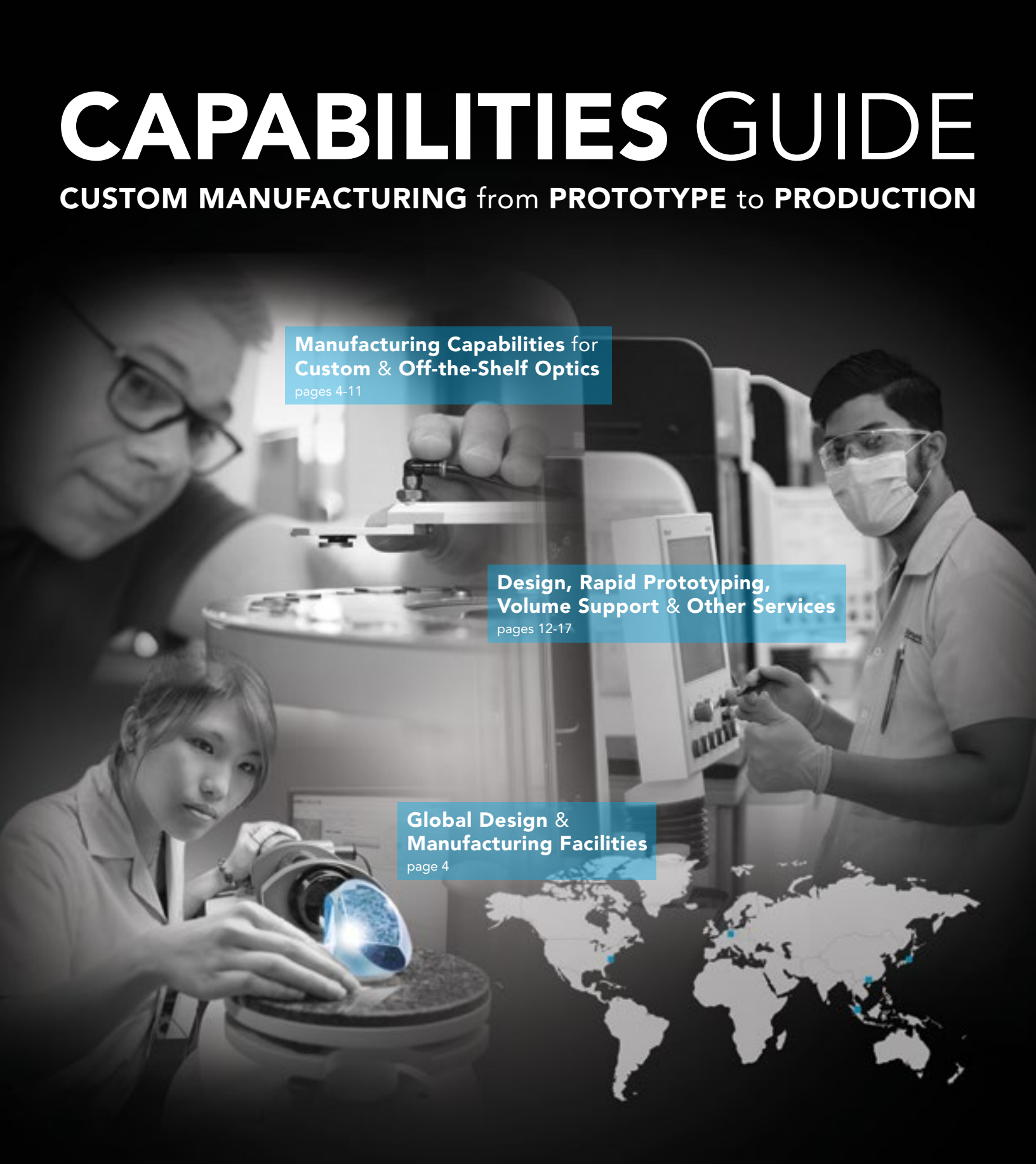
CAPABILITIES GUIDE

CUSTOM MANUFACTURING from PROTOTYPE to PRODUCTION



Manufacturing Capabilities for Custom & Off-the-Shelf Optics
pages 4-11

Design, Rapid Prototyping, Volume Support & Other Services
pages 12-17

Global Design & Manufacturing Facilities
page 4

Contact us for a Standard or Custom Quote Today!

USA: +1-856-547-3488 | **EUROPE:** +44 (0) 1904 788600
ASIA: +65 6273 6644 | **JAPAN:** +81-3-3944-6210

Edmund optics | worldwide

www.edmundmanufacturing.com

24-HOUR
TECHNICAL PHONE SUPPORT
800.363.1992 or 856.547.3488
Sunday, 8 PM – Friday, 8PM ET

VOTED **#1**
PREFERRED SUPPLIER
of optical components
11 years in a row.

Also ranked best in
Technical Support | **Product Variety**
Customer Service | **Competitive Pricing**
Lead Times | **Product Performance**
Most Innovative

- October 2018 Readex Research Industry Survey

WHO IS EDMUND OPTICS®?

The Future Depends on Optics™ and the world-changing innovations they enable. Edmund Optics® (EO) has contributed to this innovation by manufacturing and suppling industries across the globe with precision optical components and subassemblies for more than **78 years**.

Whether you need off-the-shelf optics for rapid prototyping or cost-effective custom components for volume production, we have the capabilities and engineering expertise to meet your specifications, timelines, and budgets. Our engineers create tailored solutions for unique optical challenges through expert application support, both build-to-print and completely-custom design, and a world-class quality and metrology program. Every step of the way, Edmund Optics® is committed to ensuring product and procedural quality.

We are a family-owned business with over 1,000 employees in 11 countries around the world, and we look forward to working with you!

Warm regards,

Marisa Edmund, CMO & 3rd generation owner

Contact Us for Confidential Application Support!

- Phone, Email, and Online Chat Contact Methods – Get Engineering Assistance Your Way!
- Dedicated Global Technical Support Team
- Quick Non-Disclosure Agreement (NDA) and Confidential Disclosure Agreement (CDA) Process

Leverage the Wealth of Technical Content on our Website!

- Over 132,000 Downloadable Documents and Drawings
  - 2D & 3D Drawings
  - Prescription Files
  - Coating Curves and More!
- Over 900 videos, Tech Tools, Application Notes, Articles, and FAQs in Our Online Knowledge Center

WHY EDMUND OPTICS®?

With over **78 years in business** and **5 global manufacturing facilities**, EO's promise to customers is:

MORE OPTICS, MORE TECHNOLOGY,
AND MORE SERVICE.

Selection & Reliability

- Over 34,000 Unique Optical Components Available Immediate Delivery

Service

- Free Global Technical Assistance, Applications Engineering, and Design Assistance – Available in 7 Languages

Quality

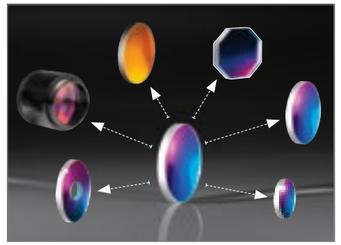
- ISO 9001 Certified and ISO 10110 Compliant with MIL-SPEC Quality Programs

FROM **PROTOTYPE** TO **VOLUME PRODUCTION**

STANDARD

On our website you can find useful product information, shop over 34,000 standard products or request free EO print catalogs. With a **>96% same day order fulfillment rate**, you can rest assured that the items you need will be in stock and ready to ship same day. Additionally, our TECHSPECH® optical components are specifically designed for efficient volume manufacture and integration, saving you time and money.

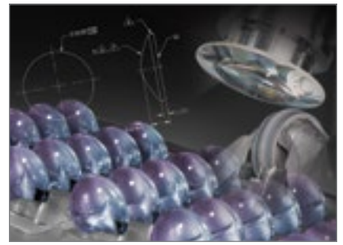
- Over 34,000 Unique Optical Components
- Available to Ship Same Day
- No Hassle 30 Day Evaluation Period and Return Policy
- Detailed Specifications, Drawings, and Prescriptions Online
- Published Price Breaks for Frequently-Ordered Quantities
- Additional OEM Volume Pricing Available



MODIFIED STANDARD

Leveraging EO's vast inventory of optical components, we can make modifications to any of our standard optical components in **2-3 weeks**. Modification services include customizing the size, shape, and edges of standard optics, improving the surface figure or accuracy of the optical surface, coating, mounting, kitting, inspecting, sorting, and more!

- Leverage EO's Extensive Standard Inventory as Your "Semi-Finished" Starting Point
- Fast 2-3 Week Turnaround
- World-Class Modification Capabilities
  - Dimensional Changes
  - Surface Treatments
  - Coatings
  - Mounting
  - Kitting and Specialized Packaging
  - Sorting and Inspection
  - Customer Specified Testing



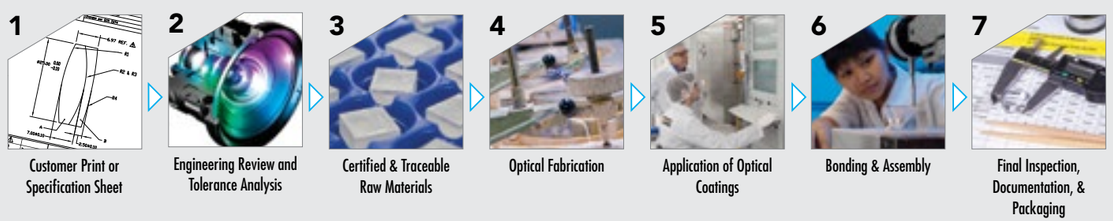
CUSTOM

Can't find what you need in our selection of standard products? Need an optic built to your specifications? We can make it for you! EO's expert design and manufacturing engineers are ready to develop a custom solution to both meet your needs and exceed your expectations.

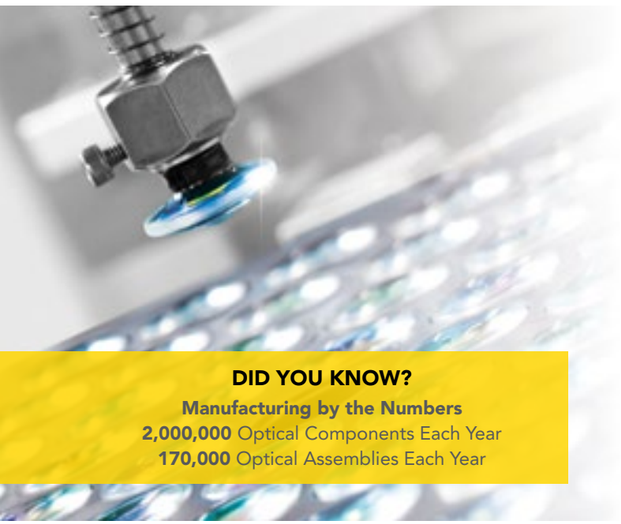
- Build-to-Print Manufacturing
- Global Manufacturing Facilities
- ITAR Registered and Compliant
- Competitive Volume Pricing
- Precision Optical Components
  - Spherical Lenses
  - Aspheric Lenses
  - Mirrors
  - Windows
  - Filters
  - Prisms
  - Cube and Plate Beamsplitters
- Precision Multi-Element Assemblies
- State-of-the-Art Metrology from Interferometry to Spectroscopy to MTF Testing
- Environmental Testing Capabilities

BUILD-TO-PRINT PROCESS

Watch our video
edmundoptics.com/
global-manufacturing



For more detailed **MANUFACTURING CAPABILITIES**, visit **www.edmundoptics.com/manufacturing**



DID YOU KNOW?
Manufacturing by the Numbers
2,000,000 Optical Components Each Year
170,000 Optical Assemblies Each Year

OVERVIEW OF **MANUFACTURING** CAPABILITIES

Aspheric Lenses....Page 5
Spherical Lenses....Page 6
Prisms....Page 6
Beamsplitters....Page 7
Absorptive Optical Filters....Page 8
Polymer Polarizers....Page 8
Mirrors....Page 9
Diamond Turning....Page 9
Optical Coatings....Page 10
Imaging Assemblies....Page 11
Laser Optics Assemblies....Page 11

GLOBAL DESIGN & MANUFACTURING

Arizona, USA
Tucson Design Center
focused design and applications engineering with over 30 years of experience

New Jersey, USA
Corporate Headquarters
120,000 sq. ft. (11,150 m²); 20,000 sq. ft. (1,860 m²) of dedicated manufacturing space. High precision fabrication, coating, assembly, and testing cells

Mainz, Germany
ITOS GmbH
7,060 sq. ft. (660 m²)
European manufacturing base for polarizers and filters

Singapore
77,000 sq. ft. (7,150 m²) of manufacturing space. Highly vertically integrated facility for volume production of spherical and aspheric lenses, prisms, and other coated and mounted optics

Shenzhen, China
16,140 sq. ft. (1,500 m²) of manufacturing space. On-site design, assembly, and testing of high volume optomechanical and imaging assemblies

Akita, Japan
80,000 sq. ft. (7,430 m²) of manufacturing space. High precision spherical lenses, prisms, and other coated optics with over 50 years of experience

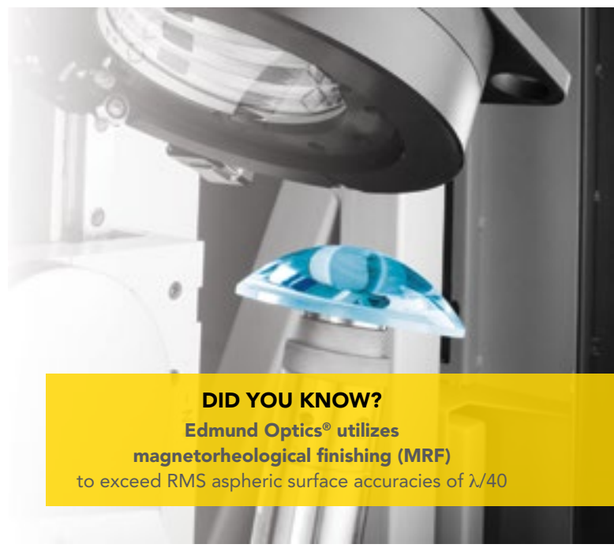
For a **FREE QUOTE**, contact us at **www.edmundoptics.com/contact-support**

POLISHED ASPHERIC LENSES

- Manufacturing in US and Singapore
- Standard and Custom, from Design and Prototype to Volume Production
- Build-to-Print Capabilities
- Over 600 Aspheric Lens Designs Available for Delivery
- MRF Fine Finishing Consistently Exceeding λ/40 Surface Accuracy and State-of-the-Art Metrology

Edmund Optics® is a recognized leader in aspheric lens manufacturing, with extensive experience producing polished aspheric lenses for ophthalmic instruments, surgical devices, analytical instruments, and defense applications. Edmund Optics®' high volume aspheric lens manufacturing cell operates 24 hours a day to produce thousands of precision aspheric lenses per month. Our manufacturing cells feature state-of-the-art production and metrology equipment, which complements our expert knowledge in aspheric lens design and manufacturing.

Whether your application calls for a standard component from our vast inventory, a build-to-print lens, or a fully customized design effort, our expert optical design and manufacturing engineers can develop solutions to meet your needs.



DID YOU KNOW?
Edmund Optics® utilizes magnetorheological finishing (MRF)
to exceed RMS aspheric surface accuracies of λ/40

Aspheric Manufacturing Capabilities

	Commercial	Precision	High Precision
Diameter:	10 - 200mm	10 - 200mm	10 - 150mm
Diameter Tolerance:	+0/-0.100mm	+0/-0.025	+0/-0.010
Asphere Figure Error (P - V):	3μm	1μm	<0.06μm
Sag:	25mm max	25mm max	25mm max
Typical Slope Error:	1μm per 1mm window	0.35μm per 1mm window	0.15μm per 1 mm window
Centering (Beam Deviation):	3 arcmin	1 arcmin	0.5 arcmin
Center Thickness Tolerance:	±0.100mm	±0.050mm	±0.010mm
Surface Quality (Scratch Dig):	80-50	40-20	10-5
Aspheric Surface Metrology:	Profilometry (2D)	Profilometry (2D & 3D)	Interferometry

MANUFACTURING EQUIPMENT

- 5-Axis CNC Grinding Machines
- 5-Axis CNC Polishing Machines
- QED MRF Finishing Machines for Fine Finishing
- Centering Machines

METROLOGY

- Talysurf PGI 1240 Profilometers
- QED ASI™ Aspheric Stitching Interferometers
- Zygo® NewView White Light Interferometers
- OptiPro UltraSurf 4X 100 Non-Contact Profilometers
- TRIOPTICS Opticentric® Centration Measurement Machines
- Zeiss Contura G2 CMMs
- Design-Specific Computer Generated Holograms (CGH)
- LUPHOScan 260 HD

For more information on **ASPHERIC LENSES**, visit **www.edmundoptics.com/capabilities/aspheric-manufacturing**

SPHERICAL LENSES

DID YOU KNOW?

Edmund Optics® is a leading manufacturer of spherical lenses, producing millions of precision quality lenses every year in our Japan and Singapore facilities

- Prototype Through High Volume Production Capabilities
- Large Variety of SCHOTT, Ohara, and CDGM Glass Types in Stock
- Build-to-Print Capabilities
- Standard and Custom Coating Options Available
- MRF Fine Finishing Consistently Exceeding λ/40 Surface Accuracy

Spherical Manufacturing Capabilities			
	Commercial	Precision	High Precision
Diameter:	4 - 200mm	4 - 200mm	4 - 200mm
Diameter Tolerance:	+0/-0.100mm	+0/-0.025mm	+0/-0.010mm
Thickness:	±0.100mm	±0.050mm	±0.010mm
Sag Height:	±0.050mm	±0.025mm	±0.010mm
Clear Aperture:	80%	90%	90%
Radius:	±0.3%	±0.1%	Fix to Test Plate
Power (P - V):	3.0λ	1.5λ	λ/2
Irregularity (P - V):	1.0λ	λ/4	λ/20
Centering (Beam Deviation):	3 arcmin	1 arcmin	0.5 arcmin
Bevel (Face Width @ 45°):	<1.0mm	<0.5mm	<0.25mm
Surface Quality:	80-50	40-20	10-5

PRISMS

DID YOU KNOW?

Custom prism manufacturing with angle tolerances down to 0.5 arcsec and irregularity down to λ/20

- Standard or Custom, from Design and Prototype to Volume Production
- Wide Assortment of Prism Shapes In Stock
- Build-to-Print Capabilities
- Available in Many Glass Types with a Variety of Standard and Custom Coatings

Prism Manufacturing Capabilities			
	Commercial	Precision	High Precision
Dimensions:	2 - 200mm	2 - 150mm	2 - 75mm
Dimensional Tolerance:	+0/-0.2mm	+0/-0.1mm	+0/-0.01mm
V-Height:	±0.25mm	±0.1mm	±0.03mm
Irregularity:	1.0λ	λ/4	λ/20
Prism Physical Angle Tolerance:	±3 arcmin	±1 arcmin	45° & 90° ±0.5 arcsec
Penta Prism Deviation:	±5 arcmin	±3 arcmin	±0.5 arcsec
Max Bevel (Face Width @ 45°):	±0.5mm	±0.3mm	±0.05mm
Surface Quality (Scratch Dig):	80-50	40-20	10-5
Bonded Prism Assembly Beam Deviation:	5 arcmin	3 arcmin	0.5 arcmin
Pyramid Tolerance:	±5 arcmin	±3 arcmin	±0.5 arcmin

BEAMSPLITTERS

- Wide Variety of Beamsplitter Types Including Polarizing, Non-Polarizing, and Laser Line
- Customized Solutions for Prototype to Volume Production
- Design & Application Expertise for Complex Coating and Geometry Needs

Edmund Optics® is a premier manufacturer of cube and plate beamsplitters for applications ranging from the ultraviolet (UV) to the infrared (IR) wavelength spectra. Our expert optical design and manufacturing engineers develop customized solutions for both prototyping and volume production, supporting you throughout your entire product development process. World-class metrology ensures that all beamsplitters meet your application requirements. What can we make for you?

Our beamsplitters are manufactured from a wide variety of SCHOTT, Ohara, and CDGM materials. Whether you require several beamsplitters for prototyping, a few dozen for pre-production, or large quantities for mass production, we can develop a solution tailored for your application. Some values may depend on material and the other required specifications.

DID YOU KNOW?

Edmund Optics® has 24 hour engineering support to help you choose the best beamsplitter for your application

Beamsplitter Manufacturing Capabilities	Commercial	Precision	High Precision
Dimensional Tolerance:	±0.15mm	±0.08	±0.04
Dimensions:	5 - 75mm	5 - 75mm	5 - 75mm
Irregularity (or Flatness):	1.0λ	λ/8	λ/20
Surface Quality (Scratch Dig):	80-50	40-20	10-5
Max Bevel (Face Width @ 45°):	±0.5mm	±0.3mm	±0.05mm
Beam Deviation:	±5 arcmin	±3 arcmin	±0.5 arcmin
|Ts - Tp| (Broadband Non-Polarizing):	<10%	<8%	<6%
|Ts - Tp| (Laser Line Non-Polarizing):	<6%	<3%	<2%
R/T Splitting Ratios (Non-Polarizing):	30/70 to 90/10	30/70 to 90/10	30/70 to 90/10
R/T Splitting Ratio Tolerance:	±15%	±10%	±5%
Extinction Ratio (Polarizing):	100:1	500:1	> 1000:1
Wavelength Range:	400 - 1620nm	400 - 1620nm	350 - 1620nm

* Some values may depend on material and the other required specifications

MANUFACTURING EQUIPMENT

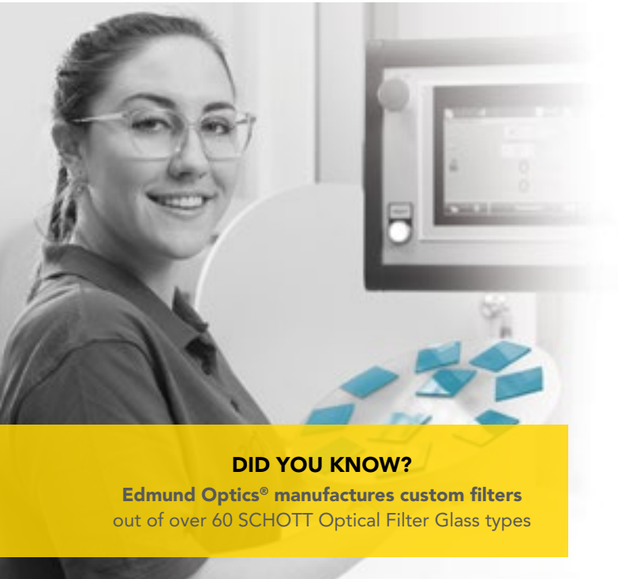
- Conventional and High-Speed Grinding Machines
- Conventional and High-Precision Polishing Machines
- Slicing Machines
- QED MRF Machines for Fine Finishing
- Coating Chambers, including Ion Beam Sputtering (IBS)
- DMG MORI® for Truncation and Shaping

METROLOGY

- OGP Smartscopes
- Nikon 6D Autocollimators
- Zygo® VeriFire™ High Resolution Interferometers
- Zygo® NewView White Light Interferometers
- Zygo® GPI 4" Aperture Vertical & Horizontal Interferometers
- Zeiss Contura G2 CMMs
- Olympus MX51 Microscopes
- Spectrophotometers
- Spectrometers

For more information on **BEAMSPLITTERS**, visit **www.edmundoptics.com/capabilities/beamsplitter-manufacturing**

ABSORPTIVE OPTICAL FILTER GLASS



- >60 SCHOTT Optical Filter Glass Types in Stock
- No Minimum Order Quantity for Either Standard or Custom Dimensions
- Build-to-Print Manufacturing and Full-Custom Design
- Rapid Turnaround for Prototypes

DID YOU KNOW?

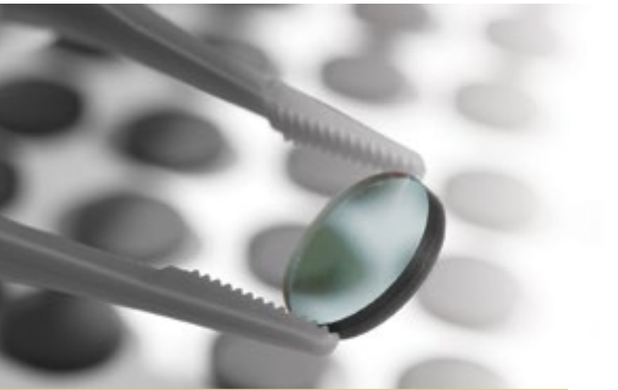
Edmund Optics® manufactures custom filters out of over 60 SCHOTT Optical Filter Glass types

Optical Filter Glass Manufacturing Capabilities

	Commercial	High Precision
Dimensions:	5 - 50mm	3 - 160mm
Dimensional Tolerances:	±0.2mm	±0.05mm
Thickness:	1, 2 , or 3mm	0.5 - 4.0mm
Thickness Tolerances:	±0.1mm	±0.05mm
Surface Finish*:	P2	P2 - P3
Surface Quality (Scratch-Dig):	80-50	20-10
Flatness:	2-3λ	λ/4
Neutral Density:	0.15 - 5.0 OD	
Geometry:	Round, Elliptical, and Rectangular	
Filter Glass Type:	Longpass, Shortpass, Bandpass, Neutral Density, and Combinations of Multiple Glasses	

* Specifications per DIN ISO 10110. Manufacturing specifications per MIL-PRF-13830B also available.

POLYMER POLARIZERS



- Wide Range of Polymer Polarizers for Visible Applications
- Custom Sizes and Shapes for Linear and Circular Polarizers, and Retarders
- Lamination on Glass or Plastic Substrates for Improved Stability
- No Minimum Order Quantities and Short Lead Times

DID YOU KNOW?

Edmund Optics® manufactures custom polarizers and retarders at ITOS, our state-of-the-art German manufacturing site

Linear Polarizer Manufacturing Capabilities*

Specifications:	Linear Polarizing Film	PMMA Laminated	Glass Laminated	Wire-Grid Polarizing Film
Dimensions:	3 x 3mm - 600 x 1000mm	3 x 3mm - 600 x 900mm	6 x 6mm - 250 x 250mm	3 x 3mm - 240 x 80mm
Diameter:	3 - 600mm	3 - 600mm	6 - 250mm	3 - 80mm
Dimensional Tolerance:	±0.20mm		±0.10mm	
Thickness:	0.18 - 0.75mm	1.00 - 3.00mm	2.00 - 3.50mm	0.08mm
Transmission:	Up to 44%			85%
Extinction Ratio:	Up to 1:30,000			1:4,250

*For specifications for circular polarizers and retarders, visit **www.edmundoptics.com/capabilities/polarizers**

MIRRORS

- Wide Variety of Metallic and Dielectric Coatings
- High Laser-Induced Damage Threshold (LIDT) and Ultra-High Reflectivity Options
- Standard or Custom, from Design and Prototype to Volume Production
- Superpolishing Capabilities for Surface Roughness Down to 0.5Å

DID YOU KNOW?

Edmund Optics® manufactures diamond turned metal mirrors as well as polished glass mirrors

Mirror Manufacturing Capabilities

	Commercial	Precision	High Precision
Dimensions:	2.5 - 406.4mm		
Dimensional Tolerance:	±0.25mm	±0.1mm	±0.05
Flatness:	4-6λ	λ/10	λ/20
Surface Quality (Scratch Dig):	80-50	40-20	10-5
Coating Options:	Metallic, Broadband Dielectric, and Dielectric Laser V-Coats		
Reflectivity (Non-Laser):	85-99.98%		
Wavelength Range Covered:	13.5nm - >40µm		
Substrate Options:	Metals, Glass, and Ceramics		
Geometries:	Flat, Elliptical, Spherical, and Parabolic		

DIAMOND TURNING

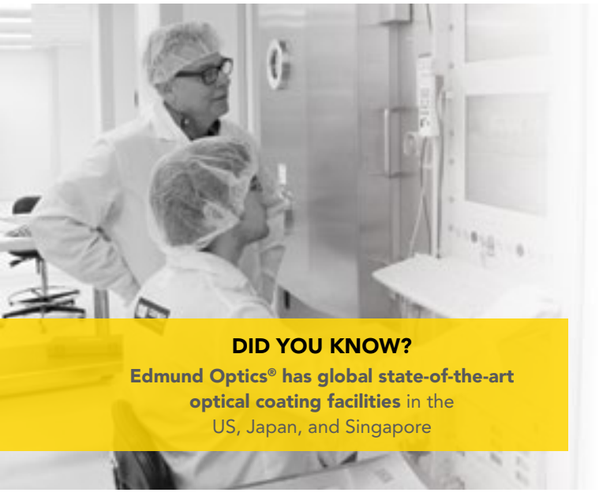
- Experts with 10+ Years' Experience
- Metals, Crystalline Materials, and Plastics
- Off-Axis Parabolic, Elliptical, and Toroidal Mirrors, Aspheric and Spherical Lenses, and Flatwork
- Build-to-Print Manufacturing and Full-Custom Design
- Wide Range of Coating Options

DID YOU KNOW?

Edmund Optics® diamond turning experts are skilled in techniques including, but not limited to, standard turning, fly cutting, and post polishing nickel

Diamond Turning Capabilities *Exact values are dependent on the specific material and size

	Commercial	Precision	High Precision
Reflected Wavefront Error (P - V @ 632nm):	λ	λ/2	λ/8
Surface Quality:	80-50	60-40	40-20
Surface Roughness (RMS) Metals*:	150Å	100Å	<30Å
Surface Roughness (RMS): Crystalline Materials and Plastics	<50Å for Diameters 6.25 - 200mm		
Geometries:	Off-Axis Parabolas, Off-Axis Ellipses, Off-Axis Toroids, Spherical Surfaces, Aspheric Surfaces, and Planar Surfaces		
Angles:	0 - 90°		
Diameter (Off-Axis):	2 - 254mm		
Diameter (On-Axis):	8 - 254mm		
Coatings:	Uncoated, Aluminum, UV Enhanced Aluminum, Protected Gold, Bare Gold, Protected Silver, Anti-Reflection, and Custom (upon request)		
Materials:	Metals (Aluminum, Copper, Brass, and Nickel-Plated Surfaces), Crystalline Materials (Germanium, Silicon, Calcium Fluoride, and Zinc Selenide), and Plastic (Acrylic and Zeonex)		



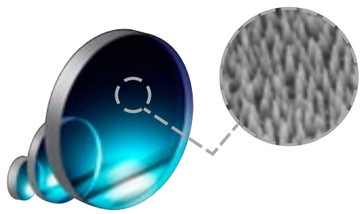
DID YOU KNOW?
Edmund Optics® has global state-of-the-art optical coating facilities in the US, Japan, and Singapore

- Internal Volume Coating Capabilities from 257nm to >40µm
- Well-Established Partners Covering Selective UV Ranges From 13.5nm to 257nm and IR Coatings from 3µm to 12µm
- Custom Coating Design from UV to LWIR Spectral Ranges
- Anti-Reflective, Highly-Reflective, Filter, Polarizing, Beamsplitter, and Metallic Designs
- High Laser-Induced Damage Threshold (LIDT) and Ultrafast Laser Coatings

Optical coatings are a critical portion of the finished optical component or assembly. Accurate optical coating design and production can mean the difference between the component failing in the field or lasting for the intended lifetime of the project. Edmund Optics® has extensive coating capabilities, and expertise in producing coatings for advanced diagnostic applications, harsh environment imaging assemblies, and applications throughout the ultraviolet (UV), visible (VIS), and infrared (IR) spectral regions. All optics are meticulously cleaned, coated, and inspected in a clean room environment, and subjected to the environmental, thermal, and durability requirements specified by our customers.

NEBULAR™ TECHNOLOGY

- Nano-Structured Anti-Reflective Surfaces for High-Power Laser Applications
- Greater than 99.8% Transmission and Near-Bulk Laser-Induced Damage Threshold (LIDT)
- Surfaces can be Tuned for Wavelengths from 340 - 1150nm



Optical Coating Capabilities	
Dimensions (Diameter or Square):	2 - 1000mm
Reflectivity:	0.1 - 99.98%
Anti-Reflective Wavelength Range:	257 - 12,000nm
Highly-Reflective Wavelength Range:	13.5 - >40,000nm
Shortpass Filter Cut-Off Wavelength:	400 - 1600nm
Longpass Filter Cut-On Wavelength:	240 - 7300nm
Bandpass Filter CWL, OD, and Bandwidth:	193 - 10,600nm, >OD 7, 1nm - Broadband
Notch Filter CWL:	355 - 1064nm
Reflective ND Filter OD:	OD 0.1 - OD 3
Filter Center Wavelength (CWL) Tolerance:	±1nm
Filter Edge Tolerance:	<1% Deviation, <0.2% Special Cases
Beamsplitter (BS) Wavelength Range:	240 - 20,000nm
BS Polarization Extinction Ratio (S:P):	10,000:1
Laser-Induced Damage Threshold (LIDT):	>40 J/cm² @ 1064nm @ 20ns @ 20Hz Pulses, Measured
Durability:	MIL-PRF-13830B APP C, PARA C.3.8.4, PARA C.3.8.5, MIL-C-48497A

MANUFACTURING EQUIPMENT

- E-Beam Deposition
- Ion-Assisted Deposition
- Ion Beam Sputtering (IBS)
- Thermal Evaporation
- Hard Coatings for Stringent Environments and Durability
- Automated Ultrasonic Cleaning

METROLOGY

- Spectrophotometers - Agilent Cary, Hitachi, PerkinElmer LAMBDA, PerkinElmer FTIR, and Varian
- DIC Microscopes
- In-House Laser-Induced Damage Threshold Testing (LIDT)
- White Light Interferometers for Group Delay Dispersion Testing
- Olympus MX51 Microscopes
- Surface Roughness Metrology
- Environmental Test Chambers: Temperature, Humidity, Salt Spray

For more information on **OPTICAL COATINGS**, visit **www.edmundoptics.com/coatings**

IMAGING ASSEMBLIES

- Full Custom Lens Design for Your Specific Needs
- Designs for Newest Technology Trends Including Stability Ruggedized Lenses, Integrated Liquid Lenses, and Ultra-High Resolutions (100+ MP)
- M12, C-Mount, Factory Automation, Telecentric Lenses, & More
- Global In-Region Engineering Support & Service
- Volume Manufacturing & Designs Optimized for Integration

Imaging Lens Assembly Capabilities	Fixed Focal Length Lenses	Telecentric Measuring Lenses	Fixed Magnification Lenses
Sensor Sizes:	Up to 43.3mm	Up to 43.3mm	Up to 90mm
Resolution:	Up to 120 MegaPixels	Up to 32 MegaPixels	Up to 16k Line Scan
Field of View:	>105°	Up to 242mm	0.2mm - 186mm
Lens Mounts:	C-Mount, TFL-Mount, F-Mount, S-Mount, M42	C-Mount, F-Mount, M42	C-Mount, F-Mount, M42, M72

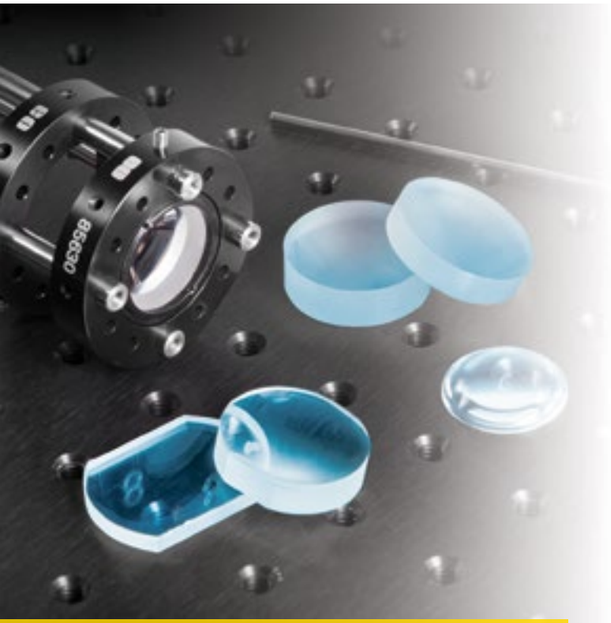
DID YOU KNOW?
Edmund Optics® has customer-focused imaging labs to find optical, camera, and lighting solutions for challenging customer objects

LASER OPTICS ASSEMBLIES

- Beam Expanders, Focusing Objectives, and Other Laser Optics Assemblies
- Laser Line and Broadband Coatings from 257nm to 3µm
- Low Group Delay Dispersion (GDD) Designs for Ultrafast Systems, Including Reflective Designs
- High-Power Assemblies with No Issues from Internally-Focusing Ghost Images
- Standard, Modified Standard, or Custom, from Design and Prototype to Volume Production

Beam Expander Capabilities	
Expansion Power:	1X - 20X
Design Wavelengths:	Common Laser Lines Including Nd:YAG, Yb:YAG, Ti:sapphire, and Tm/Ho-Doped Fiber Lasers, Broadband
Mounts:	C-Mount, M22, M30
Focusing Mechanisms Available:	Sliding Optics, Rotating Optics, Fixed Focus
Custom Design Capabilities:	Yes, Contact Us Today!

DID YOU KNOW?
Edmund Optics® does full assembly development from modeling physical optics propagation, to designing lens elements, to coating, to assembly, to testing



DID YOU KNOW?

You can combine multiple modification services on the same optical component, such as resizing and coating, to reduce overall lead time and cost.

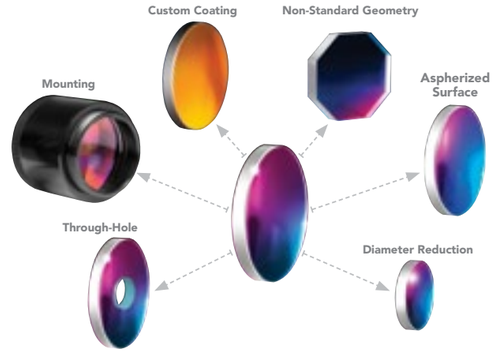
CUSTOMIZED OPTICS IN **2-3 WEEKS**

When developing a product, being able to quickly and easily iterate your prototypes is critical.

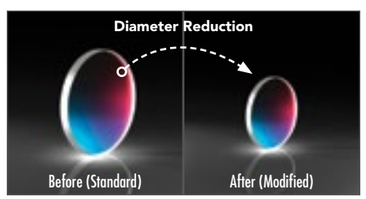
In addition to our immediately available inventory of over 34,000 standard optics, quick "modified standard" customizations are available in just **2-3 weeks**, simplifying the path to production.

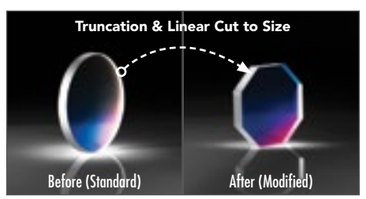
Our modification services include: customizing the size, shape, and edges of standard optics; improving the surface figure or accuracy of the optical surface; sorting; mounting; kitting; inspection; and more! Find an achromat that has everything you need, but it's just a little too big? We can edge it down for you. What about that mirror that you need in a non-standard size? We can cut it for you. Looking for a customized inspection report? We can measure it for you.

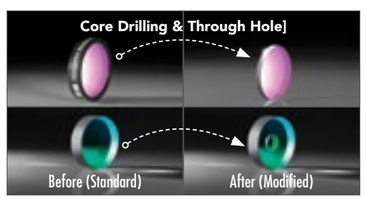
One Standard Optic = Infinite Possibilities

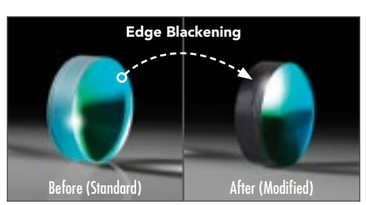


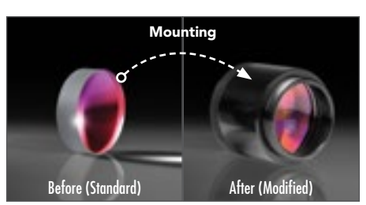
MODIFICATION SERVICES OFFERED

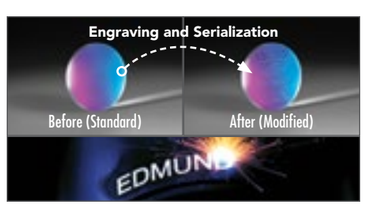










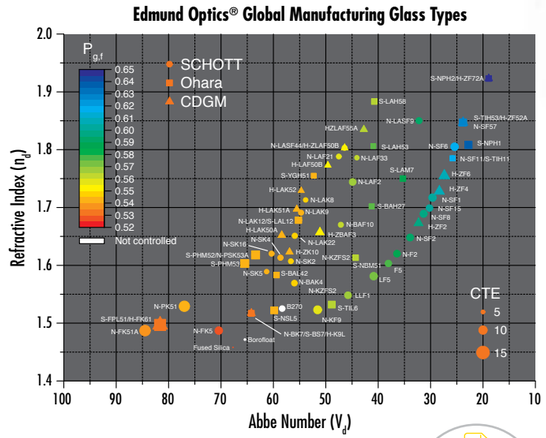


WHAT CAN WE MAKE FOR YOU? Learn more at **www.edmundoptics.com/modify**

FULL CUSTOM FAST!

If off-the-shelf or modified standard components do not meet your prototyping needs, you can utilize our fully-custom prototyping capabilities to obtain custom glass components in a matter of days to a maximum of a few weeks.

Edmund Optics® maintains an inventory of over 70 of the most common optical glass types at all manufacturing sites. Using these materials reduces lead time of raw materials and facilitates quick prototyping.



Glass map indicating the Refractive Index (n_d), Abbe Number (V_d), Coefficient of Thermal Expansion (CTE), and Relative Partial Dispersion ($P_{g,f}$).

Download this chart edmundoptics.com/**EO-glass**

DID YOU KNOW?

EO has been able to turn around **fully-custom spherical lenses** in **3 weeks or less**

13 CREATIVE "HACKS" FOR **RAPID PROTOTYPING**

While every application has its own timelines, credentials, and specifications, there are several techniques that may be commonly utilized to decrease the amount of time required for prototyping. Below are several of the 13 creative "hacks" that can be used to quickly and efficiently make prototypes of optical sub-systems:

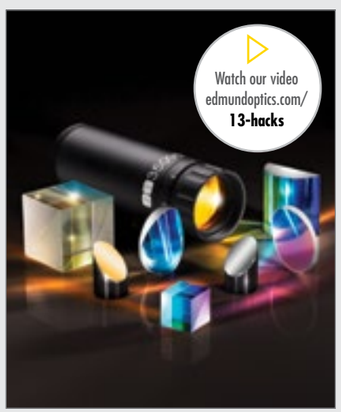
#1 – Go monochromatic to reduce element count and complexity

#2 – Approximate custom "best-form" elements with available standard singlets

#3 – Flip imaging lenses to use them as objectives

#4 – Customize compound assemblies with standard optics

#5 – Utilize inner diameter threaded prototyping tubes



For **FULL GLASS and ZEMAX GLASS CATALOGS**, visit **www.edmundoptics.com/preferred-glass**

VOLUME AND OEM SUPPORT

DID YOU KNOW?
Edmund Optics® manufactures **over 2 million optical components** and **170,000 optical assemblies every year** at our global facilities.

Edmund Optics® manufactures and supplies customers around the globe with millions of precision optical components and optical assemblies. Whether standard, modified standard, or custom, we have the expertise and resources necessary to manufacture optical products based on your project's specific requirements. Our dedicated and skilled team members ensure that you receive the optimal solution for your application, while our quality assurance teams guarantee the best final products.

Additional Requirements? We've Got You Covered!

- Highly Flexible Volume Order Servicing
- Support Blanket Orders and Other Stocking Agreements
- Competitive Volume Discounts
- Well Versed in Configuration Control, Change Control, and Copy Exact Requirements
- Seamless Federal Acquisition Regulation (FAR), Defense Federal Acquisition Regulation (DFAR), Quality Assurance Provision (QAP), and Testing Requirement Flow-Downs
- ITAR Registered and Compliant; Defense Priorities and Allocations System (DPAS) Servicing and Support
- Global Supply Chain Network with Global Warehousing – Quickly and Easily Supporting Your Projects Wherever You Prefer
- Comprehensive First Article Inspection Reports (FAIR) for Product Qualification

DEDICATED **SUPPORT TEAMS** FOR YOUR NEEDS

Meet the team!
edmundoptics.com/meet-the-team

All customers with volume orders receive a dedicated support team to ensure their products are manufactured and specified to meet their needs, deadlines are kept, and a specified point of contact for general or technical questions is assigned. The support team consists of a project manager, solutions engineer, OEM sales representative, and regional sales manager.

SAMPLE DEDICATED SUPPORT TEAM

Project Manager
The Project Manager coordinates all internal activities to meet project cost, schedule, and performance requirements for optical assemblies.

Solutions Engineer
Your technical resource for your custom optics requirements provides suggestions on cost-effective and manufacturable optics specifications.

OEM Sales Rep
Your dedicated sales representative assists with volume price quotes, order placement, and delivery status to meet your project deadlines.

Regional Sales Manager
Your dedicated account manager provides on-site support and capability knowledge to develop and grow our relationship with you.

For more information on **VOLUME and OEM SERVICES**, visit **www.edmundoptics.com/volume**

LAUNCH AND PRODUCTION

6 WEEK
VOLUME PRODUCTION TIME

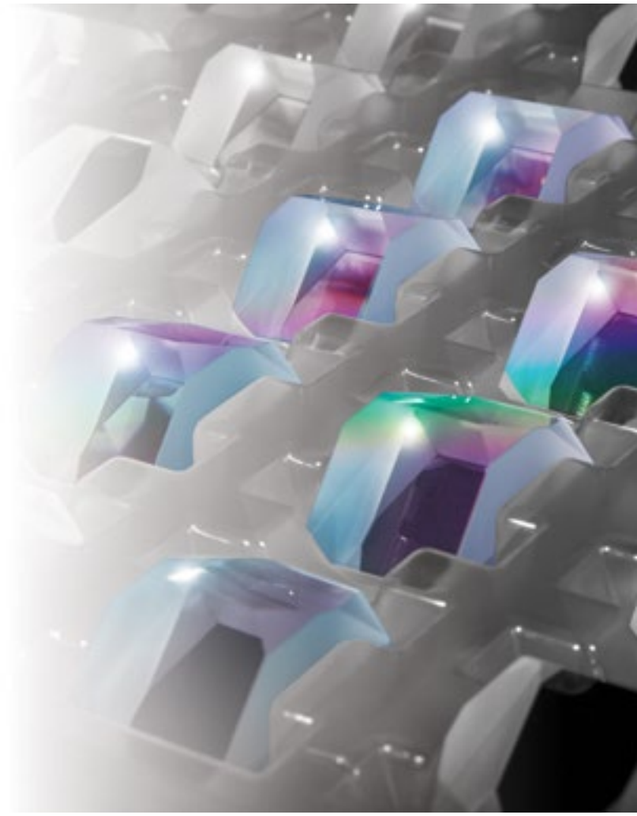
Edmund Optics® is proud to offer industry-leading **6 week production times** for **volume orders** of **custom optical components** at no premium!*

In addition to our quality and customer service, we pride ourselves on speed and accuracy. We understand that ever-shrinking development and product cycles make short lead times crucial to many of our customers. For this reason, we offer quick turnaround solutions to get you the optics you need within your specified timelines.

**Dependent on quantity, specifications, and glass availability. Exact lead time to be acknowledged at the time of order.*

ENGAGE WITH US
EARLY AND OFTEN

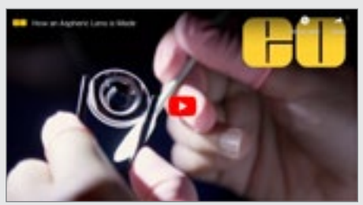
Speaking with our experts during your proof-of-concept phase can help significantly expedite custom manufacturing. We can help provide feedback on specifications to choose for your components and review your design for manufacturability, while assisting with possible cost reduction measures once your project moves from prototype to production.



BEHIND THE SCENES IN OPTICAL MANUFACTURING

Watch the following two videos to see the manufacturing processes of both **aspheric lenses** and **imaging lens assemblies** in Edmund Optics' global manufacturing facilities.

How an Aspheric Lens is Made



www.edmundoptics.com/making-an-asphere

How an EO Imaging Lens is Made

www.edmundoptics.com/making-an-imaging-lens

For a **FREE QUOTE**, contact us at **www.edmundoptics.com/contact-support**

DESIGN SERVICES

- Over 30 Years of Experience Designing Optical Components and Optomechanical Assemblies
- Analysis Expertise Spans Zemax, Code V®, FRED™, Solidworks, Matlab®, Abaqus, and More
- Regional Engineering Support & Service Across the Globe
- Designs Optimized for Integration and High Production Yields

Edmund Optics® offers a variety of design services in order to meet the specialized needs of our customers. We excel at designing optical and optomechanical systems from components to assemblies and imaging to laser optics, spanning from the UV to IR. Our design engineers are well versed in tolerancing and complex optical and mechanical analysis.

Whether standard or custom, we have found that approaching the design and proof-of-concept stage with an eye towards manufacturability at the onset yields the fastest, most affordable, and most effective results. EO engineers are prepared to take your project from design to prototype to volume production.

Zemax · code V · FRED Optimum · SolidWorks




DID YOU KNOW?

EO has over 150 engineers on staff, located at each of our global sales offices and manufacturing facilities, as well as our two dedicated design service locations in **Arizona** and **China**.

For more **DESIGN ASSISTANCE**, visit **www.edmundoptics.com/design**

TIPS FOR DESIGNING **MANUFACTURABLE LENSES** AND **ASSEMBLIES**

A successful lens design succeeds not only in the creation of a working model but also in manufacturing, assembly, testing, and implementation.

Visit this online resource to learn the nuances of designing manufacturable lens assemblies including:

- Geometry Considerations
- Tolerancing Methods and Assumptions
- Modeling Surface Irregularity
- Stack-ups of Assembled Systems

www.edmundoptics.com/manufacturable-lenses

QUALITY AND **METROLOGY**

- Robust Global Compliance Systems
- Thorough Preventative and Corrective Action Procedures
- Commitment to Continuous Improvement
- ISO 9001:2015 Certified and ITAR Compliant

Edmund Optics® is committed to ensuring product and procedural quality. Guided by ISO 9001 certification standards, we employ a strict global quality program that is monitored by experienced staff and supported by the most innovative optical testing available. EO manufactured products undergo rigorous and thorough testing as part of our quality program and in compliance with EO's global quality procedures, as well as a host of ISO and mil-spec standards.

Additionally, Edmund Optics® has documented plans for improving resource efficiency and waste reduction through the Environmental Management System (EMS) ISO 14001. We hope our initiative will develop and sustain both supply and demand for greener goods, services and products, and reduce waste both in and outside of the company.

EDMUND OPTICS® IS COMPLIANT WITH:

- ISO 9001:2015
- ISO 14001
- ANSI / ASME Y14.5
- ISO 10110
- MIL-C-48497A
- MIL-STD-810
- MIL-PRF-13830B
- MIL-C-675C

STATE-OF-THE-ART **METROLOGY**

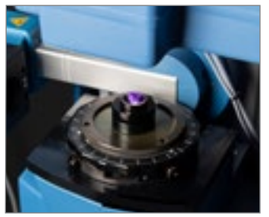
OPTICAL METROLOGY CAPABILITIES

- Interferometers, Profilometers, Coordinate Measurement Machines (CMM), and a host of Optical and Mechanical Metrology
- Radiometrics: Stray Light, Veiling Glare, and More
- Semi-Automated MTF Measurement Equipment
- UV/VIS/NIR/IR Coating Characterization through Varian and PerkinElmer Spectrophotometers and Fourier Transform Infrared (FTIR) Spectroscopy
- Laser-Induced Damage Threshold (LIDT) and Beam Quality (M^2) Measurement
- Environmental Testing Equipment such as Vibration, Humidity, and Immersion
- Over 50 Employees in Quality Control Functions Across the Company
- Product Testing and Certification Reports Available Upon Request

IN-HOUSE OPTICAL ASSEMBLY TESTING

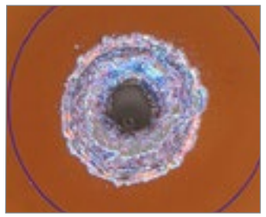
- MTF
- Stray Light
- Telecentricity
- Wavefront Distortion
- White Light Interferometry
- Mechanical Profilometry
- Much More!

QED® ASI™ Aspheric Stitching Interferometer



Trioptics ImageMaster® MTF Test Station

Zygo® Interferometer



Laser-Induced Damage Threshold (LIDT) Testing

To learn more about our **STATE-OF-THE-ART METROLOGY**, visit **www.edmundoptics.com/metrology**

5 TIPS
FOR DESIGNING WITH OFF-THE-SHELF OPTICS

Using **off-the-shelf optics** in your next design project comes with many advantages.

If budget or time restrictions eliminate the possibility of utilizing custom optics in your application, standard optics are readily available and easily implemented to fit your design requirements. Here are some quick tips to help make designing with off-the-shelf optics easy!

1 SIMPLIFY

Start on paper with a paraxial design and break it into subsystems of finite and infinite conjugate optical groups. Determine the focal lengths you want for each group before trying to optimize in a code such as Zemax, Code V®, or another ray tracing software of your choice. Once you have the focal lengths required, you can start using paraxial equations to help choose the off-the-shelf lenses that provide the required focal lengths. Your preferred ray tracing code should have a selection of off-the-shelf lenses built into it (***Figure 1***) that you can use to model the selected lenses and optimize your spacing. If not, the lenses can typically be input into the software with the information provided by the supplier. All EO TECHSPEC® components are available in most design codes and Zemax files are available on our website at **www.edmundoptics.com/zemax**

2 GO MONOCHROMATIC

If at all possible, use a monochromatic source such as an LED or Laser or use an optical filter to make your system monochromatic. Using a monochromatic or narrow band light will greatly reduce the complexity of the design. As a rough guideline, reducing the source waveband to less than 50nm will generally make using singlets possible in your design. Chromatic aberrations cause difficulty when composing a design, so your options will be simplified if a broadband light source is not required.

3 UTILIZE OFF-THE-SHELF SUBSYSTEMS

By using off-the-shelf components such as achromatic doublets, microscope objectives, machine vision lenses, multi-element relays, or other subsystems, you can often achieve your application's exact correction requirements for factors such as color, field angles, and large apertures. In many cases, these subsystems can even be modeled in your code if the prescriptions are provided by the supplier (***Figure 2***). Even if the prescription is not available, a paraxial surface can be used to approximate the subsystem.

4 CONSIDER MOUNTING OPTIONS

Whether prototyping or trying to save the time and expense associated with purchasing custom housings, consider off-the-shelf mounting options. For example, the TECHSPEC® Optical Cage System allows you to easily assemble your optical components and provide plenty of freedom for making spacing adjustments. Most off-the-shelf cage systems allow for mounting common optical component sizes, as well as ways for mounting microscope objectives, C-mount camera lenses, and other subcomponents (***Figure 3***).

5 USE COMPONENTS WHERE THEY WORK

Off-the-shelf lenses such as Plano-Convex (PCX), Plano-Concave (PCV), Double-Convex (DCX), Double-Concave (DCV), and Achromats are optimized for small fields and small apertures. These components work best when integrated into systems that do not have very steep ray angles. For example, when designing a high magnification relay, use a complex multi-element subsystem for the high numerical aperture side of the relay and an achromat for the low numerical aperture side. For instance, a 15X system consisting of a 20X infinite conjugate objective on the object side and a 150mm focal length achromatic lens on the image side, will provide a very well-corrected system.

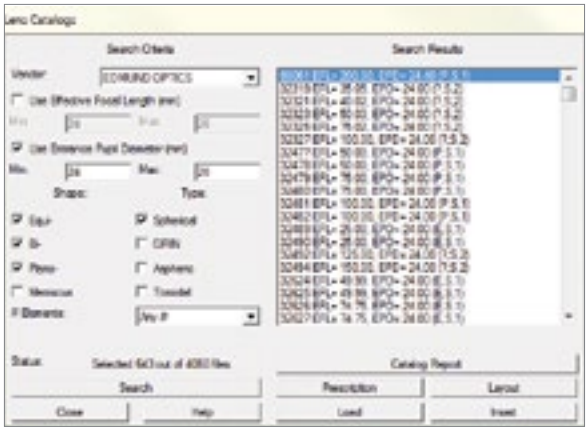


Figure 1: Lens Catalog from Zemax

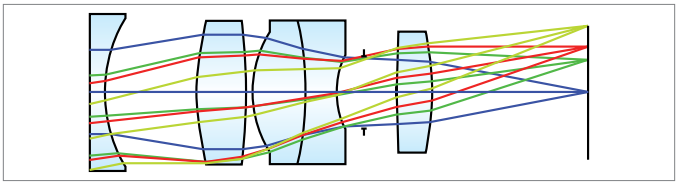


Figure 2: Prescription of EO M12 µ-Video Lens (#58-204)

Figure 3: The TECHSPEC® Optical Cage System is ideal for prototyping due to its flexibility and high durability

For more **OPTICS APPLICATION NOTES**, visit **www.edmundoptics.com/appnotes**

MANUFACTURING CAPABILITIES RESOURCE GUIDE

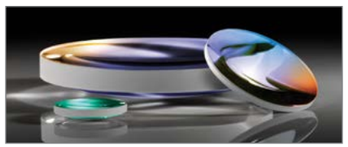
Try our **Modify Standard Optics** Service!

ASPHERIC LENSES

- 600+ Standard Aspheres Ready for Purchase
- Edmund Optics® is One of the Largest Aspheric Lens Manufacturers in the World

Aspheric Manufacturing Capabilities	Commercial	Precision	High Precision
Diameter:	10 - 200mm	10 - 200mm	10 - 200mm
Diameter Tolerance:	+0/-0.100mm	+0/-0.025mm	+0/-0.010mm
Asphere Figure Error (P - V):	3µm	1µm	<0.06µm
Sag:	25mm max	25mm max	25mm max
Typical Slope Error:	1µm per 1mm window	0.35µm per 1mm window	0.15µm per 1 mm window
Centering (Beam Deviation):	3 arcmin	1 arcmin	0.5 arcmin
Center Thickness Tolerance:	±0.100mm	±0.050mm	±0.010mm
Surface Quality (Scratch Dig):	80-50	40-20	10-5
Aspheric Surface Metrology:	Profilometry (2D)	Profilometry (2D & 3D)	Interferometry

SPHERICAL LENSES



- 6,300+ Standard Spherical Lenses Ready for Purchase
- Available in Glass and Crystalline Materials with a Variety of Standard and Custom Coatings

Spherical Manufacturing Capabilities	Commercial	Precision	High Precision
Diameter	4 - 200mm	4 - 200mm	4 - 150mm
Diameter Tolerance	+0/-0.100mm	+0/-0.025mm	+0/-0.010mm
Thickness	±0.100mm	±0.050mm	±0.010mm
Sag Height	±0.050mm	±0.025mm	±0.010mm
Clear Aperture	80%	90%	90%
Radius	±0.3%	±0.1%	Fix to Test Plate
Power (P - V)	3.0λ	1.5λ	λ/2
Irregularity (P - V)	1.0λ	λ/4	λ/20
Centering (Beam Deviation)	3 arcmin	1 arcmin	0.5 arcmin
Bevel (Face width @45 degrees)	<1.0mm	<0.5mm	<0.25mm
Surface Quality	80-50	40-20	10-5

PRISMS

- Custom Prisms in a Wide Variety of Geometries
- Angle Tolerances Down to 0.5 arcsec and Irregularity Down to λ/20

Prism Manufacturing Capabilities	Commercial	Precision	High Precision
Dimensions	2 - 200mm	2 - 150mm	2 - 75mm
Dimensional Tolerance	+0/-0.2mm	+0/-0.1mm	+0/-0.01mm
V-Height	±0.25mm	±0.1mm	±0.03mm
Irregularity	1.0λ	λ/4	λ/20
Prism Physical Angle Tolerance	±3 arcmin	±1 arcmin	45° & 90° ±0.5 arcsec
Penta Prism Deviation	±5 arcmin	±3 arcmin	±0.5 arcsec
Max Bevel (Face Width @ 45°)	±0.5mm	±0.3mm	±0.05mm
Surface Quality (Scratch Dig)	80-50	40-20	10-5
Bonded Prism Assembly Beam Deviation	5 arcmin	3 arcmin	0.5 arcmin
Pyramid Tolerance	±5 arcmin	±3 arcmin	±0.5 arcmin

BEAMSPLITTERS

- Cube, Plate, Polarizing, Non-Polarizing, and Laser Line Capabilities
- Design and Application Expertise for Complex Coating and Geometry Needs

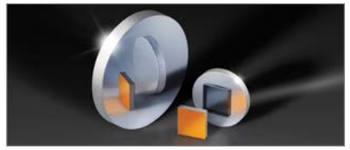
Beamsplitter Manufacturing Capabilities	Commercial	Precision	High Precision
Dimensional Tolerance	±0.15mm	±0.08	±0.04
Dimensions	5 - 75mm	5 - 75mm	5 - 75mm
Irregularity (or Flatness)	1.0λ	λ/8	λ/20
Surface Quality (Scratch Dig)	80-50	40-20	10-5
Max Bevel (Face Width @ 45°)	±0.5mm	±0.3mm	±0.05mm
Beam Deviation	±5 arcmin	±3 arcmin	±0.5 arcmin
|Ts – Tp| (Broadband Non-Polarizing)	<10%	<8%	<6%
|Ts – Tp| (Laser Line Non-Polarizing)	<6%	<3%	<2%
R/T Splitting Ratios (Non-Polarizing)	30/70 to 90/10	30/70 to 90/10	30/70 to 90/10
R/T Splitting Ratio Tolerance	±15%	±10%	±5%
Extinction Ratio (Polarizing)	100:1	500:1	>1000:1
Wavelength Range	400 - 1620nm	400 - 1620nm	350 - 1620nm

Try our **Modify Standard Optics** Service!

MANUFACTURING CAPABILITIES RESOURCE GUIDE

Mirror Manufacturing Capabilities	Commercial	Precision	High Precision
Dimensions:	2.5 - 406.4mm		
Dimensional Tolerance:	±0.25mm	±0.1mm	±0.05
Flatness:	4-6λ	λ/10	λ/20
Surface Quality (Scratch Dig):	80-50	40-20	10-5
Coating Options:	Metallic, Broadband Dielectric, and Dielectric Laser Line		
Reflectivity (Non-Laser):	85 - 99.98%		
Wavelength Range Covered:	13.5nm - >40µm		
Substrate Options:	Metals, Glass, and Ceramics		
Geometries:	Flat, Elliptical, Spherical, and Parabolic		

MIRRORS



- 2,000+ Standard Mirrors Ready for Purchase
- High Laser-Induced Damage Threshold (LIDT) and Ultra-High Reflectivity Options

Optical Coating Capabilities	
Dimensions (Diameter or Square):	2 - 1000mm
Reflectivity:	0.1 - 99.98%
Anti-Reflective Wavelength Range:	266 - 12,000nm
Highly-Reflective Wavelength Range:	13.5 - >40,000nm
Shortpass Filter Cut-Off Wavelength:	400 - 1600nm
Longpass Filter Cut-On Wavelength:	240 - 7300nm
Bandpass Filter CWL, OD, and Bandwidth:	193 - 10,600nm, >OD 7, 1nm - Broadband
Notch Filter CWL:	355 - 1064nm
Reflective ND Filter OD:	OD 0.1 - OD 3
Filter Center Wavelength (CWL) Tolerance:	±1nm
Filter Edge Tolerance:	<1% Deviation, <0.2% Special Cases
Beamsplitter (BS) Wavelength Range:	240 - 20,000nm
BS Polarization Extinction Ratio (S:P):	10,000:1
Laser-Induced Damage Threshold (LIDT):	>40 J/cm² @ 1064nm @ 20ns @ 20Hz Pulses, Measured
Durability:	MIL-PRF-13830B APP C, PARA C.3.8.4, PARA C.3.8.5, MIL-C-48497A

OPTICAL COATINGS

- In-House Custom Coating Design
- Anti-Reflective, Highly-Reflective, Filter, Polarizing, Beamsplitter, and Metallic Designs

Imaging Lens Assembly Capabilities	Fixed Focal Length Lenses	Telecentric Measuring Lenses	Fixed Magnification Lenses
Sensor Sizes:	Up to 43.3mm	Up to 43.3mm	Up to 90mm
Resolution:	Up to 120 MegaPixels	Up to 32 MegaPixels	Up to 16k Line Scan
Field of View:	>105°	Up to 242mm	0.2mm - 186mm
Lens Mounts:	C-Mount, TFL-Mount, F-Mount, S-Mount, M42	C-Mount, F-Mount, M42	C-Mount, F-Mount, M42, M72

IMAGING ASSEMBLIES

- Over 1.5 Million Imaging Lenses Sold
- Global In-Region Engineering Support & Service

Beam Expander Capabilities	
Expansion Power:	1X - 20X
Design Wavelengths:	Common Laser Lines Including Nd:YAG, Yb:YAG, Ti:sapphire, and Tm/Ho-Doped Fiber Lasers, Broadband
Mounts:	C-Mount, M22, M30
Focusing Mechanisms Available:	Sliding Optics, Rotating Optics, Fixed Focus
Custom Design Capabilities:	Yes, Contact Us Today!

LASER OPTICS ASSEMBLIES

- Beam Expanders, Focusing Objectives, and Other Laser Optics Assemblies
- Laser Line and Broadband Coatings from 257nm - 3µm

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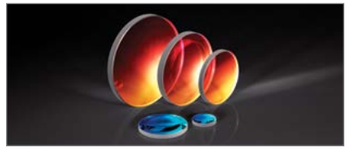
MANUFACTURING CAPABILITIES RESOURCE GUIDE

Try our **Modify Standard Optics** Service!

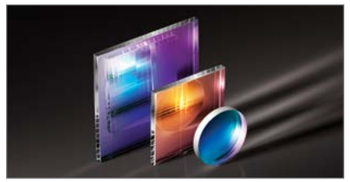
OPTICAL WINDOWS



- Wide Variety of Substrates Including Ge, Si, N-BK7, Fused Silica, ZnSe, and KBr
- Anti-Reflection Coating Options from the UV to IR

Window Manufacturing Capabilities	Commercial	Precision	High Precision
Dimensions:	2.5 - 406.4mm		
Dimensional Tolerance:	±0.25mm	±0.1mm	±0.05
Flatness:	4-6λ	λ/10	λ/20
Surface Quality (Scratch Dig):	80-50	40-20	10-5
Parallelism:	5 arcmin	1 arcmin	5 arcsec
Coating Options:	BBAR for UV, VIS, and IR, Laser AR V-Coats		
Wavelength Range Covered:	193nm - 14µm		
Substrate Options:	Optical Glass, Fused Silica, Ge, Si, ZnSe, CaF2, Sapphire, and Others		

OPTICAL FILTER GLASS

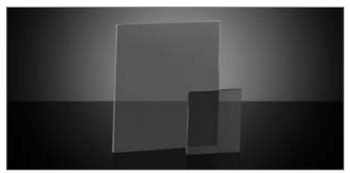


- >60 SCHOTT Optical Filter Glass Types in Stock
- No Minimum Order Quantity

Optical Filter Glass Manufacturing Capabilities	Commercial	High Precision
Dimensions:	5 - 50mm	3 - 160mm
Dimensional Tolerances:	±0.2mm	±0.05mm
Thickness:	1, 2 , or 3mm	0.5 - 4.0mm
Thickness Tolerances:	±0.1mm	±0.05mm
Surface Finish*:	P2	P2 - P3
Surface Quality (Scratch-Dig):	80-50	20-10
Flatness:	2-3λ	λ/4
Neutral Density:	0.15 - 5.0 OD	
Geometry:	Round, Elliptical, and Rectangular	
Filter Glass Type:	Longpass, Shortpass, Bandpass, Neutral Density, and Combinations of Multiple Glasses	

* Specifications per DIN ISO 10110. Manufacturing specifications per MIL-PRF-13830B also available.

POLYMER POLARIZERS

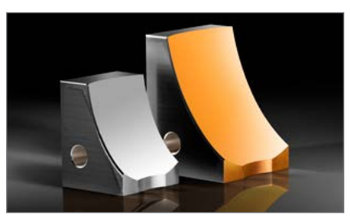


- Custom Polarizers Manufactured in ITOS, our German Manufacturing Facility
- No Minimum Order Quantity

Linear Polarizer Manufacturing Capabilities*	Linear Polarizing Film	PMMA Laminated	Glass Laminated	Wire-Grid Polarizing Film
Dimensions:	3 x 3mm - 600 x 1000mm	3 x 3mm - 600 x 900mm	6 x 6mm - 250 x 250mm	3 x 3mm - 240 x 80mm
Diameter:	3 - 600mm	3 - 600mm	6 - 250mm	3 - 80mm
Dimensional Tolerance:	±0.20mm		±0.10mm	
Thickness:	0.18 - 0.75mm	1.00 - 3.00mm	2.00 - 3.50mm	0.08mm
Transmission:	Up to 44%			85%
Extinction Ratio:	Up to 1:30,000			1:4,250

*For specifications for circular polarizers and retarders, visit **www.edmundoptics.com/capabilities/polarizers**

DIAMOND TURNING



- In-House Experts with 10+ Years' Experience
- Precision Diamond Turning of Metals, Crystalline Materials, and Plastics

Diamond Turning Capabilities	Commercial	Precision	High Precision
Reflected Wavefront Error (P - V @ 632nm):	λ	λ/2	λ/8
Surface Quality:	80-50	60-40	40-20
Surface Roughness (RMS) Metals*:	150Å	100Å	<30Å
Surface Roughness (RMS): Crystalline Materials and Plastics	<50Å for Diameters 6.25 - 200mm		
Geometries:	Off-Axis Parabolas, Off-Axis Ellipses, Off-Axis Toroids, Spherical Surfaces, Aspheric Surfaces, and Planar Surfaces		
Angles:	0 - 90°		
Diameter (Off-Axis):	2 - 254mm		
Diameter (On-Axis):	8 - 254mm		
Coatings:	Uncoated, Aluminum, UV Enhanced Aluminum, Protected Gold, Bare Gold, Protected Silver, Anti-Reflection, and Custom (upon request)		
Materials:	Metals (Aluminum, Copper, Brass, and Nickel-Plated Surfaces), Crystalline Materials (Germanium, Silicon, Calcium Fluoride, and Zinc Selenide), and Plastic (Acrylic and Zeonex)		

*Exact values are dependent on the specific material and size

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$350.00	$315.00	
$350.00	$315.00	
$350.00	$315.00	

Tear Along the Dotted Line